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FEATURE ARTICLE

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Extron's Twisted Pair Transmitters and Receivers Solve Connection Challenges

Long Distance Transmission of A/V Signals Over Twisted Pair Cabling

Extron Twisted Pair transmitters and receivers

Application: you have an A/V system to install. You're down to one last decision: cables. What do you do if you have to hide a bundle of coaxial cable because of your client's sense of aesthetics? Or what if the building's facilities manager only wants shielded or unshielded twisted pair (STP or UTP) cable to be used, like Category 5 (CAT 5), 5e, or 6? Or what if the university already has CAT 5 cable wired throughout its newly purchased property and wants to use the existing cable infrastructure?

...Of course, you are interested in maintaining picture quality.

Sometimes the considerations and environment you're working with preclude the use of coaxial cable, or an alternative is requested. One alternative—a growing trend, in fact—is the use of UTP cabling to carry high resolution analog video signals. UTP cable is normally associated with digital signal distribution and low resolution composite video. UTP technology has characteristics that are advantages or disadvantages depending on the specifics of the application.

UTP cable is a viable alternative in many scenarios:

• In a corporate boardroom, there is a long cable run between the A/V rack and a ceiling-mounted projector with built-in speakers. The cable needs to be lightweight so it can be discreetly hidden within the boardroom's decor.

• Your client company is located on two floors of an office building. The building's facilities manager mandates the use of only UTP cabling in all common areas, so you are required to use UTP for the new company-wide, A/V system.

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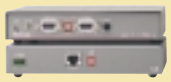
Extron's Product Line of Twisted Pair Transmitters & Receivers

Transmitters

CAT 5 T AV
CAT 5 Video and Audio Transmitter

Extron's CAT 5 T AV accepts NTSC/PAL composite video with stereo audio.



CAT 5 T 15HD A
CAT 5 Interface Transmitter

Extron's CAT 5 T 15HD A accepts analog computer video with PC audio.

CAT 5 T 15HD AV
CAT 5 Interface/ Composite Video and Audio Transmitter

Extron's CAT 5 T 15HD AV accepts analog computer video with PC audio as well as NTSC/PAL composite video with stereo audio.

CAT 5 T BNC
CAT 5 RGB Video Transmitter

Extron's CAT 5 T BNC accepts RGBHV, RGBS, RGsB, component video, S-video, or composite video signals.

CAT 5 T BNC DA4
CAT 5 RGB Video Distribution Amplifier/Transmitter

Extron's CAT 5 T BNC DA4 is a one input, four output distribution amplifier that accepts RGBHV signals.

Receivers

CAT 5 R AV
Cat 5 Video and Audio Receiver

Extron's CAT 5 R AV receives long-distance transmission of NTSC/PAL composite video with stereo audio.

CAT 5 R BNC A
CAT 5 RGB Video and Audio Receiver

Extron's CAT 5 R BNC A receives long-distance transmissions of RGB video, component video, S-video, or composite video with stereo audio.

CAT 5 R BNC AV
CAT 5 RGB Video, Composite Video and Audio Receiver

Extron's CAT 5 R BNC AV combines all of the functionality and connections of the CAT 5 R BNC and the CAT 5 R BNC AV into one enclosure.

- At a large venue awards presentation, audience members in the back of the auditorium use monitors to get close-up views of the onstage action. For long cable runs from the A/V rack to the ceiling-mounted monitors, UTP cable is more economical.

- For a staging event or tradeshow, the A/V crew needs to quickly run temporary cabling that can be taken down with no hassle—or even discarded at little cost.

- A college wants to use the existing UTP cable infrastructure, and there is plenty of UTP wiring for A/V signals, separate from the phone and computer network systems (A/V signals must be run separately from the other types of signals).

For other scenarios, UTP is a less viable choice. For short cable runs, UTP is a more complicated and more costly cable to use than coaxial cable because there is a high initial, fixed cost. This expense is inevitable because of the need for UTP transmitters and receivers. Special transmitter and receivers sets are required for two reasons:

1) The main reason is signal transmission. A special type of signal (differential analog) is used to make the best use of UTP wire despite its limitations. To transmit video over UTP, a special transmitter is needed to convert the video to a differential analog signal that is a better match for UTP wire. At the receiving end, a receiver is needed to convert the differential analog signal back to a usable video signal.

2) A less significant reason is connectorization. A/V components typically don't use the RJ-45 connectors that UTP cable uses.

Also, coaxial cable systems have better quality and consistency, while being lower-cost, than UTP cable systems when cable runs are shorter than 200 ft. (61 m). Coaxial cable is also more uniform at these shorter distances, since lengths of wire pairs often vary within the same UTP cable due to small differences in twist tension and rates.

UTP Cabling

UTP cabling was originally developed by the computer industry for transmitting digital data over computer networks. Using UTP for video is not simply a matter of soldering BNC connectors to the wire and then connecting equipment together. It's vital to treat your UTP system as an A/V system.

In any A/V system, the displayed image quality is only as good as the weakest link in the video signal chain. In most cases, that weakest link is the cable. This holds especially true for UTP transmission systems. To achieve the best possible image quality with a UTP system, the highest quality UTP cable, connectors, and patch cords available should be used. At this time, Category 6 rated UTP cable is manufactured to the most exacting specifications. Designed for Gigabit Ethernet, CAT 6 cable provides 250 to 350 MHz of bandwidth as well as the best crosstalk and attenuation specs available for UTP cable. To run video over UTP and get professional results, Extron has designed a transmission system to compensate and correct for signal losses that occur during a UTP cable run. However, for best results, it is important to know the kind of transmission cable that connects the transmitter to the receiver.

Although UTP cable installed in a facility can be used, it is important to note that this cable may be of unknown quality and has been designed for computer network use with termination in an IP network patch bay, digital switching system, or router. The balanced analog video signals transmitted by Extron transmitters are not compatible with digital network equipment. Mixing signals can cause damage to a router if a signal is mistakenly connected to the wrong piece of equipment. If possible, a UTP video system should be treated as an A/V system with all signal cables and connections kept separate from the computer and data systems in a facility. When possible, a direct cable run from transmitter to receiver should be used. (For more information on UTP Cabling, see the Tech Corner article in this issue on page 22.)

Extron UTP Products

Extron's family of Twisted Pair transmitters and receivers are designed to integrate Twisted Pair cabling into analog A/V systems. Our Twisted Pair solutions are designed to be used the way A/V system designers and installers build systems—offering the compact size, connectorization, remote control capability, and mounting configurations needed for architectural integration plus the level and peaking control needed for high performance.

Extron offers a versatile class of transmitters and receivers that enable long-distance transmission of RGB video,

component video, S-video, composite video, and stereo audio using Category 5, 5e, or 6 UTP or STP cable. They use exclusive, proprietary technology developed by Extron to transmit signals up to 1,000 ft. depending on signal frequency and cable quality—640 x 480 video up to 1,000 ft. (305 m) or 1600 x 1280 video up to 200 ft. (61 m).

Extron's UTP products allow A/V system designers and installers to provide reliable, professional-quality signal transmission while gaining the benefits of using UTP cabling. UTP cabling is a fraction of the size of coaxial cable, as well as being less expensive, more space-efficient, and easier to pull due to its smaller size and greater flexibility. Termination of the UTP cable with RJ-45 connectors is simple, quick, and economical.

For example, at a large venue meeting with multiple break-out rooms, computer-video and/or video sources, such as PCs, DVD players, or VCRs, may be rack-mounted in the A/V equipment room. The source signals are then routed via UTP cables to displays in break-out rooms located far from the A/V equipment room.

Twisted Pair System Design

Configurations– The Extron family of five transmitters and three receivers allows the installer to mix and match devices for a custom configuration to meet an application's specific needs (see product sidebar on page 2). Depending on the layout of the various sources and destinations, these compactly sized devices can be selected and placed as needed. RGB and audio/video signals can originate at the same point using a dual input transmitter, or at separate points in the system using separate transmitters. RGB and audio/video signals can terminate together at the same point using a dual output receiver, or at separate points using separate receivers. (See **Figure 1**.)

Connectorization– Depending on the transmitter selected, a variety of input connectors are used:

- Female 15-pin HD connector for computer-video input
- 3.5 mm mini jack for PC audio input
- RCA connectors for composite video and stereo audio input
- BNC connectors for computer or RGB video, component video, S-video, or composite video input.

Receivers output video on BNCs and have both unbalanced RCA audio jacks and balanced/unbalanced 3.5 mm captive screw connectors for easy integration into switching systems and/or direct connections to the display.

Signal Adjustments– There is no need for additional signal enhancement devices. Each receiver provides automatic or manual level and peaking control for cable length compensation.

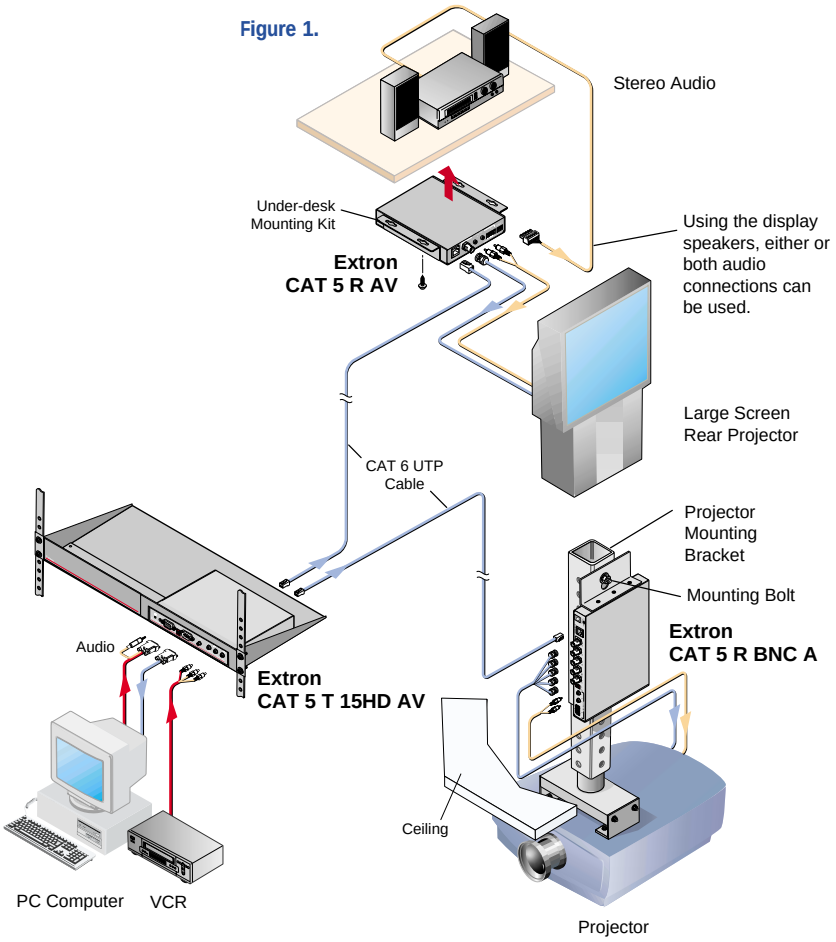
Architectural Integration

Remote power capability– Each transmitter can be powered by its receiver for any cable distance of 300 ft. (91 m) or less [800 ft. (244 m) or less for the CAT 5 T AV], so in many installations, the transmitter doesn't require a local power supply. No need for a power drop at the source's location—a laptop can run on its own battery, or the computer can use the sole electrical outlet available. Each Twisted Pair product includes a 15VDC, external power supply, except for the CAT 5 T AV and CAT 5 R BNC AV. The power supply for the CAT 5 T AV is optional, and the CAT 5 R BNC AV includes a 100-240VAC, 50/60 Hz, auto-switchable, internal power supply.

Mounting options– Optional under-desk, through-desk, and projector-mount mounting kits are available for easy connection to sources or destinations. Transmitters can be mounted under desks, through desktops, or on equipment rack shelves. Receivers can be easily mounted on rack shelves or at the display.

Specialized knowledge of Twisted Pair technology and testing is vital for the design and installation of UTP systems that yield maximum image quality and minimal installation effort and time. For additional information, Extron offers a white paper on UTP Technology. Please visit the Technologies tab at www.extron.com and click on the UTP Category 5/5e/6 button.

Figure 1.



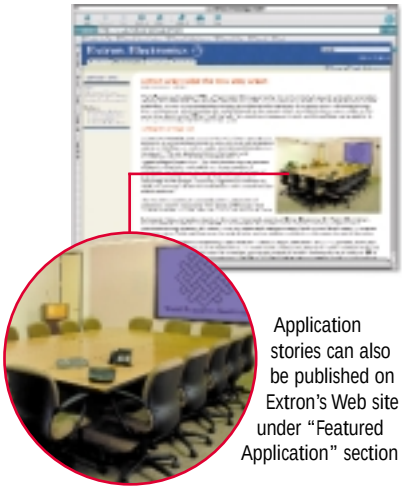
by Lee Dodson, Vice President of Marketing

Improve Your Image

The best way for potential customers to judge the quality of work you are capable of delivering is to show them examples of it. The solution is simple: just take the hand of the next customer who comes through your door and take them to see your best installations. Simple, right?

Application Stories

Application stories can be published in ExtroNews



Application stories can also be published on Extron's Web site under "Featured Application" section

O.K., hauling them around the state or country to see your work is not always convenient or practical. Distance, access rights, schedules, cost, and time are just a few of the more bothersome obstacles that make this difficult. However, this difficulty does not reduce the power or need to provide credible evidence of one's abilities. Unfortunately, finding a suitable next-best option is not so simple.

Many integrators assemble portfolios of pictures from prior installations to use in supporting sales for future customers. These can be categorized and organized by system type and cost level. Professional photography cannot be undervalued in this case. Much as a hardware manufacturer invests in the quality of their brochures, an integrator's product is installations and deserves the same attention. The portfolio approach can be effective if presented well by the salesperson. However, these tend to be somewhat flat and are not effective without someone to explain and position the systems. Nevertheless, this is the first step in creating effective sales materials.

A good way to augment the standard portfolio is to *create professional application stories with pictures and testimonials.* Multiple people in multiple locations can use these. *Application stories written and composed properly can be very persuasive instruments to build your company's image, communicate ideas, establish credibility, validate theories, and show workmanship.* Integrating customer testimonials can further build credibility and help remove the marketing "hype" of a sales pitch.

Although these are not a substitute for physical examples and demonstrations, application stories can go a long way to illustrate and exemplify systems and concepts. Furthermore, these can be used for pro-active marketing like handouts and mailings to entice prospects to select your firm among their myriad (and confusing) choices.

Many integrators do not have the luxury of dedicated marketing professionals available to create these useful materials. Fortunately, Extron has a permanent staff of experienced writers and graphic designers who are always looking for good material to incorporate into our communications, like ExtroNews, our Web site, and other media. Integrators who we have helped write application stories and feature here in ExtroNews have often requested extra copies of the newsletter for their distribution, which we are happy to provide. For further information, please contact Extron's PR/Media Manager, Rosia Senh at rsenh@extron.com or 714.491.1500, ext. 6398.

by Jeff Gibson, Vice President of Sales

E-Demos: Training Tools at Your Fingertips

When I try to describe to people who aren't in the A/V industry what kinds of products Extron manufactures, I sometimes get blank stares in return. While most people have experienced professional audio/visual environments in sports bars, conference rooms, classrooms, or churches, few understand what goes on behind the scenes to make everything work.

These are the same people who make the decisions about equipment purchases for professional A/V installations. Explaining to end users what all this equipment does and why it's necessary can be a challenge. Even for those who have been in this industry for years, keeping up with all the new product developments and options for application environments can be a difficult task.

To make learning about what Extron products do and how they operate a little easier, we've created a training tool for A/V dealers—E-Demos. E-Demos are computer-based product demonstrations. These electronic product demos are like mini-animated movies that can be played on a desktop or laptop computer. Computer graphics and audio narration explain in simple terms what a product does, how to operate it and where to use it. The E-Demo format lets viewers zoom in and out on images for a close and detailed look at the product.

E-Demos are designed for both one-on-one learning environments and for larger group presentations. They can be used to train employees on the latest Extron products and as sales tools to demonstrate to clients how products fit into a specific A/V application.

For ease of use, we've made E-Demos available in several formats. Through the Extron Web site (www.extron.com), they can be viewed online using one of two Internet connection speeds: low speed for use with a 56.6 kbps modem or high speed for everything faster. E-Demos can also be downloaded from the Web, making them as portable as a laptop computer. Additionally, we've put the first seven demos on a mini CD-ROM and mailed a copy to every Extron dealer. E-Demos from the CD-ROM are great to use for one-on-one product training or group training in places where Web access is not practical. If you'd like additional copies of the CD-ROM, please call your Extron Customer Support Representative (US: 800.633.9876, Europe+800.3987.6673, Asia: +65.383.4400). For the latest E-Demo, check the Extron Web site (www.extron.com).

by Steve Somers, Vice President of Engineering

Getting the Most from SDI

SDI does NOT stand for "Short Distance Interface." But, a serial digital interface run can revert to that status if some basic rules are not followed.

The Serial Digital Interface-SDI (SMPTE 259M) grew out of the need for longer distance connection of component digital television equipment, the result being the viability of a truly digital broadcast station. SDI is capable of running hundreds of feet and can run thousands of feet if properly distributed. For additional information on SDI, see my articles in the January – April 2000 and the September – October 2000 ExtroNews.

Taking It One Bit At A Time

Digital component recording began in 1987 with the creation of the D1 format (SMPTE 125M). The D1 interface is an 8/10 bit parallel system intended for close-in connection between digital tape recorders (19 mm tape). Its interface cabling is short due to the difficulty in maintaining proper bit timing over a byte-wide data channel. Somewhat like DVI, D1 requires management of differential signals over 8 or 10 twisted pairs. Bit skew, crosstalk, and attenuation are adversarial to the task of transmitting parallel D1 for long distances. The interface uses a 25-pin D-sub miniature connector. As a result, termination is not really easy, and the thought of managing that many parallel bits through a router is good for a migraine, not to mention the hardware cost of 10 switching planes. Therefore, parallel D1 connections are easily managed over only a few meters.

Reformatting the byte-wide D1 data via a serializer yields a very high-speed serial data stream. Serializing a 10-bit data word results in a data rate ten times faster. The 27 MHz D1 data becomes serial data at 270 megabits per second for standard component NTSC. See **Figure 1** (below) showing the basic conversion methodology. Benchmark signal performance is captured in **Figure 2** (on opposite page).

Why SDI?

Although SDI bit rates are very high, distribution of serial data as a single cable connection presents significant advantages. First, it's much easier (read cheaper) to route and switch one cable than a parallel system

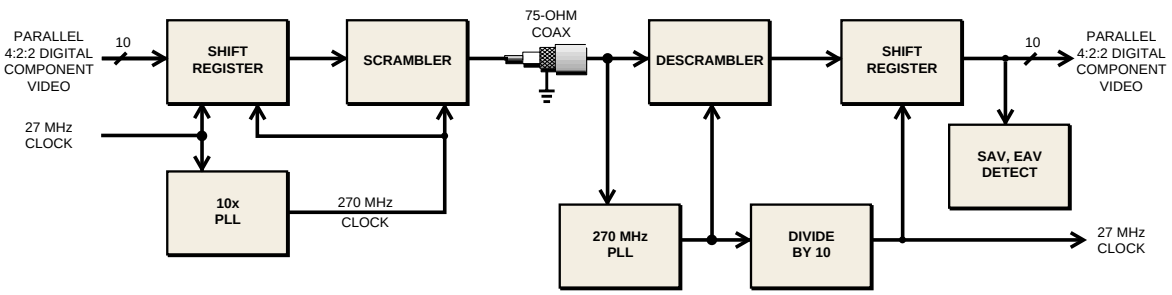


Figure 1. 4:2:2 Serial Digital Interface

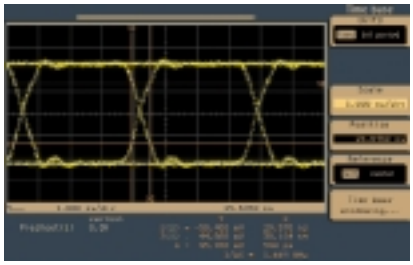


Figure 2. Standard reference level SDI signal conforming to SMPTE 259M

of cables. Having all data bits organized as one stream means there will be no issues with clock and data synchronization. Managing bit timing and cable equalization is easier. Data skew problems encountered with multi-conductor cables do not exist.

As seen in the operational diagram, Figure 1, the SDI format utilizes a differential signaling technique and NRZI (non-return to zero inverted) coding. Although SDI is transmitted as an unbalanced signal on 75-ohm coax, transmission and reception involves differential amplifiers that format and detect, respectively, both data phases. Utilizing differential reception creates additional headroom and robustness in signal-to-noise performance. Pseudo-randomizing the data bits and use of NRZI coding increases channel transmission reliability. NRZI coding is desirable because its operation is independent of signal polarity. In this coding scheme, high and low levels do not communicate data 1s or 0s. High and low states are detected simply by the change from one level to another. A zero means that the transmission level stays the same, while a one is transmitted each time the level transitions from one level to the other.

SDI is more immune to extraneous noise and low frequency components (hum) because the receiver takes one phase of the data transmission, inverts it, and then adds it to the in-phase portion. Like a regular analog differential amplifier, common mode noise induced into the signal is cancelled out during this inversion and addition operation.

So, what problems do exist? As in life, all modes of travel have distinct advantages and disadvantages. One must weigh the relative difference. Key factors affecting SDI are cable attenuation, signal jitter, signal wander, error detection/handling (EDH), and receiver sensitivity. See **Table 1** for a list of the SDI rates supported within SMPTE 259M.

Cable Quality is Job 1

The single largest effect on SDI transmission rests with the quality of cable used relative to the transmission distance required. Any 75-ohm coaxial cable may be used for SDI. The big question is always: "How far can I go?"

SMPTE 259M guides us in determining cable transmission length. It states that, for a class A receiver (the best type to have), the maximum transmission distance is given by a coaxial cable length having 30dB attenuation at one-half the SDI clock rate. For example, at the 270 Mbps rate for component NTSC, one half the rate is 135 MHz. Many cable specification tables show attenuation in dB at 135 MHz since this is a popular rate. Taking the attenuation value for a 100-foot cable at 135 MHz and scaling it the 30dB limit (attenuation is linear) gives us the maximum cable length. If we have a specified loss of 10dB at 135 MHz at 100 feet, then the maximum usable length will be at 30dB divided by 10dB times 100 feet, which is 300 feet for that cable.

Utilizing the maximum calculated cable length in a primary distribution run for SDI is NOT a good idea. Suppose you have made the maximum length run. Now, you connect a 10-foot patch cable at the end to include some other device and, suddenly, there is no video image! You have just experienced the "cliff effect." When the loss parameters of the SDI signal exceed the receiver's ability to recapture the data, the system completely

continued on next page

	SMPTE 259M			
	Level A	Level B	Level C	Level D
Parameter	NTSC 4fsc Composite	PAL 4fsc Composite	525/625 Component	525/625 Component
Data Rate in Mbps (clock)	143	177	270	360
1/2 Clock Rate in MHz	71.5	88.5	135	180
Signal Amplitude (pk–pk)	800 mV	800 mV	800 mV	800 mV
DC Offset (volts)	0 +/- 0.5	0 +/- 0.5	0 +/- 0.5	0 +/- 0.5
Rise/fall Time Max. (nS)	1.50	1.50	1.50	1.50
Rise/fall Time Min. (nS)	0.40	0.40	0.40	0.40
Rise/fall Time Differential (nS)	0.5	0.5	0.5	0.5
% Overshoot Max.	10	10	10	10
Timing Jitter (nS)	1.40	1.13	0.74	0.56
Alignment Jitter (nS)	1.40	1.13	0.74	0.56

Table 1. SMPTE 259M transmission rates and specifications

fails, ungracefully. For this reason, allow at least 10% margin in your cable length calculations to account for other connection changes, connector resistances, connector and termination reflections, etc. Most pre-calculated cable charts build in this allowance just for good practice. See **Table 2** for calculated cable lengths for Extron cables.

There's Clocking, And Then There's Re-clocking

All digital data is derived and managed by a repetitive pulse train called a clock… the literal heartbeat of the machine. Without it, data transitions could not be identified in a coherent way. Either, digital data somehow contains the clock information embedded within it, or the clock signal accompanies the data separately. Since SDI is a singular wire transmission scheme, the clock is embedded. Therefore, not only does cable attenuation affect recovery of data, it seriously affects the receiver's ability to recover the clock signal such that the system can stay synchronized.

This is where basic cable attenuation comes in. The maximum cable distance is governed by the receiver's ability to recover clock and data reliably. As the digital cliff is approached, bit errors typically appear and escalate rapidly toward transmission failure. But, (you say) I need to transmit SDI over 1,000 feet and the best cable I have available is not guaranteed much beyond that. What will I do?

The solution is straightforward. Position an SDI receiving device in the line at a point where reliable communication is maintained. Make sure this device is a true SDI receiver that can equalize and re-clock the signal. In analog signal transmission systems there is no really good way to reform and transmit the signal while still maintaining good linearity. With digital data streams, however, the data can be captured and reconstructed by a "squaring" circuit that restores the original risetime of the signal. Because we aren't concerned about linearity in digital data, the data can be indefinitely reconditioned as long as good signal conditioning practices are followed. When SDI is reconditioned for retransmission, the data edges are sped up and the original timing accuracy restored. This operation is referred to as "re-clocking." Now, we can run the additional distance our cabling system will allow.

To Re-clock Or Not To Re-clock

Yes, that is a question. Properly re-clocking SDI calls for additional circuit complexity and cost. Good SDI matrix routers include re-clocking systems. Further, it's a good idea to consider the location of a router in a new installation such that cabling distances can work to your advantage toward minimizing the number of repeating stations, or re-clocking points, required. Routers are typically the focal point for re-clocking data. SDI distribution amplifiers can involve a receiver/re-clocker circuit as well. In major installations having large routers, it is common for the router to have re-clocking ability at the input and at the output as well. Why? The actual propagation distance and loss effects through some large routers represent a serious impairment to SDI signals. Therefore, re-clocking may be included at the output to ensure signal quality for the next long cable run.

Now, back to the question. Do I need to always re-clock SDI signal runs? No. Suppose you have a relatively small set of cable runs involving a small matrix router and good receivers at each destination. Good SDI receivers can recover the signal under some surprising signal degradation conditions. In some cases, adding the wrong equipment into the line (or something having a poor re-clocking system) may actually increase signal jitter, which makes recovery more difficult. As long as you carefully maintain signal quality and are not in danger of exceeding cabling distances, you do not necessarily need to re-clock. Re-clocking is primarily intended to clean up long run losses, allow easier decoding, and redrive additional cable runs.

An analog matrix router under the right conditions can handle SDI nicely. The key issue is whether the router will introduce crosstalk or other noise that may affect the signal jitter performance. If the router is bandwidth limited, performance will be directly affected as high frequencies are attenuated rapidly. You must look at router bandwidth specs to see if the SDI risetime can be accommodated without significant effect. Since the SDI signal is about 800

	SMPTE 259M							
	Level A		Level B		Level C		Level D	
Application	NTSC 4fsc Composite		PAL 4fsc Composite		525/625 Component		525/625 Component	
Data Rate in Mbps (clock) 1/2 Clock Rate in MHz	143 72		177 89		270 135		360 180	
Extron Cable Product	FEET	METERS	FEET	METERS	FEET	METERS	FEET	METERS
Mini-HR (22-020-xx)	583	178	531	162	428	130	365	111
RC, 24 gauge (22-127-02)	813	248	736	224	600	183	519	158
RC, 20 gauge (22-124-02)	1034	315	944	288	801	244	687	209
SHR (22-098-02)	1406	429	1274	388	1067	325	915	279

Table 2. Recommended Serial Digital (SDI) Transmission Distances through Coaxial Cable

millivolts peak-to-peak, it is not much different in level than standard video signals. SDI is uni-directional and has a good signal-to-noise recovery budget. So, with care, smaller, local routing systems can work on a budget without re-clocking.

Got The Jitters?

Signal jitter is another culprit in SDI systems. Maintenance of the timing relationship to a common timing reference provides auto-phasing recovery circuits in the receiver the ability to lock onto and decode the clock and video data. When an external factor, such as random noise, affects the absolute bit timing, the receiver encounters difficulty recovering clock and data. Cable loss affects the amplitude of the SDI signal while jitter affects the zero crossing point of the data edges. The data edges appear to dance back and forth with random uncertainty. There is a jitter budget allowance, but since noise and jitter effects can become generally random, bit error rate can creep up periodically and cause lost data. If the jitter budget is exceeded, data cannot be recovered at all.

As with analog signals, once you have noise in the signal, it is extremely difficult and costly to remove. Jitter caused by induced noise effects, unstable signal sources, or poor re-clocking systems is the demise of digital signals. Sometimes, basic signal attenuation effects are mistaken as signal jitter. SDI signals contain a range of low to high frequencies like analog signals. Cable attenuation still affects the high frequencies most. When looking at an eye pattern, the data zero crossing point (risetime/falltime area) appears wider than normal. The eye pattern is typically used to evaluate signal quality including jitter. This appears to smear the data edges and look as though large amounts of jitter are present, when, in fact, measurement with SDI measurement equipment may show the signal well within jitter specifications. Jitter measurements should be made with instrumentation capable of proper measurement. SMPTE Engineering Guideline, EG-33-1998, Jitter Characteristics and Measurements provides in-depth help for this task (www.smpte.org). See **Figure 3**.

Born To Wander

With the deployment of more digital video networks, the monitoring of video sync timing is more critical than before. In some applications, where time-base correctors or frame synchronizers are not used, problems with image shifts and hue errors may occur because of network induced wander of sync and color burst timing. This condition creates "video wander," which is defined as sync signal phase variations below 10 Hertz. When the video signal is converted to composite, this effect is not easy to remove.[1] Specialized television test equipment, such as the Tektronix VM700T, can easily measure horizontal sync timing jitter and wander for serial digital systems.

Digital Safety Net

All of the aforementioned situations in addition to poor connections and improper terminations can cause data bit errors to occur. A bit error is defined as a change in one or more data values occurring between the source and destination. SDI includes an error detection and handling (EDH) system that can monitor data quality and provide some visibility of errors as well as location. Some bit errors may not affect picture quality directly but may signal impending failure. Groupings of bit errors may affect picture quality, sound, or both. SDI equipment will typically incorporate some level of EDH reporting or troubleshooting capability.[2]

Receivers – Some Are So Insensitive To Your Needs

SMPTE 259M mentions a typical range of expected SDI receiver sensitivity between 20dB and 30dB at one-half the data clock frequency. Further, proper cable equalization should be employed. What is cable equalization? It is a feature of the receiver's front-end amplifier that adjusts its gain to compensate for higher losses in the signal at the higher frequencies received, while maintaining lower gain settings for the lower frequencies. This is important for proper alignment and triggering with changing data edges so as to ensure consistent video recovery.

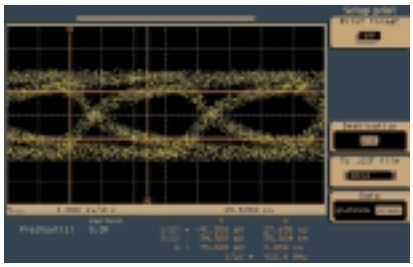


Figure 3. Eye pattern shows normal cable losses, yet jitter is still well within specs.

Looking back at our earlier example we used for calculating maximum cable length, our cable run was 300 feet for a 10dB loss cable at 135 MHz at 100 feet. Now, if we have a less sensitive receiver, say the 20dB type, our drive distance will decrease to 20dB divided by 10dB times 100 feet, or, only 200 feet. You can see there is a ratio of 2/3 here. This nominal 10dB performance spread in receivers severely limits SDI cable run lengths.

Remember, all things being equal, pay careful attention to receiver sensitivity and cable attenuation specs for realizing the most from SDI signal distribution. While good routers utilize re-clocking, the need for this feature primarily depends on the size and complexity of your system design. Be aware that good signal sources, routers, and proper cable routing techniques help reduce the invasion of signal jitter.

Footnotes:

1. *Measuring Wander in Video Distribution Systems, by Tom Tucker, Tektronix (http://www.Tektronix.com/Measurement/App_Notes/Published_Articles/measwander/index.html)*
2. *Monitoring in the Digital Environment, by Ted Gary, Broadcast Engineering, November 1999 (http://www.broadcastengineering.com/archives/1199/199911be40.html)*

Extron CVEQ1

CVEQ1 Gets the Line Driving Job Done—Discreetly

The CVEQ1 is a one input, one output, composite video and stereo audio line driver with variable video gain and equalization capability. The CVEQ1 is designed to compensate for signal attenuation and high frequency loss encountered during a long cable run.

Scenario: You have a presentation in a ballroom, and you need to send the high resolution camera's feed to TV monitors in a press room on a different floor of the conference center. What's the best way to do that?

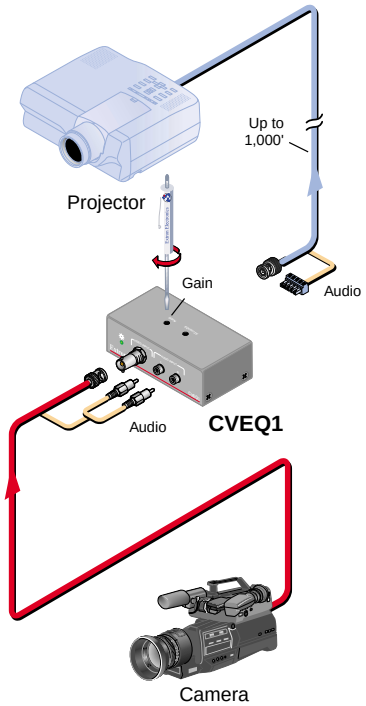
Solution: Convert the component video to composite video for transmission over the long cable run. Then use the Extron CVEQ1 to deliver the composite video signal to the press room. If the press room has multiple displays, then use a DA to run the signal to the various displays in the room.

Applications

Rental and staging applications frequently use a variety of signals, such as composite video, S-video, component video, and/or RGB. In this Rental & Staging Corner article, we will focus on composite video runs. Oftentimes, higher-resolution signals are scan converted down to composite video when quality isn't as important for certain displays, or when the destinations don't accept higher resolution signals, e.g. delay monitors or TVs in overflow rooms at large-venue presentations or events.

Another common example is when devices are often placed behind the stage curtain—no time or need to rack-mount all the equipment. The CVEQ1 is small and compact, so it can be situated anywhere and easily moved—features that are especially vital for rental and staging applications. The CVEQ1 can be placed near its source, behind the scenes, without taking up a lot of room. Top panel controls give A/V technicians easy access to peaking/equalization and gain adjustments for reducing signal degradation. A power light is great for troubleshooting; it lets you know if a problem is caused by lack of power or lack of signal. Plus, the CVEQ1 is easy to hook up—just connect the cables and (use a Tweeker to) equalize the signal.

One CVEQ1 application is shown in the diagram below. Such an application



would occur at a concert hall, where a stage camera's output is sent over a long distance to a projector on the ceiling of the concert hall.

The CVEQ1 is also ideal for large venues when one video switcher feeds multiple devices. When an application involves multiple composite video signals being run a variety of distances, individual signal adjustments are required to deliver signals of equivalent signal strength to each display. Each signal should be equalized exactly for its cable's distance, so that all images are clear or match each other. These types of applications require a separate equalizer for each signal. Examples include tradeshows, conference rooms, and ballrooms, when there are varying composite video signal runs of 100 ft., 250 ft., 500 ft., 1,000 ft. to remotely located displays.

Features of the CVEQ1

The CVEQ1 is compatible with any NTSC, PAL, or SECAM device, such as a VCR or video camera. The CVEQ1 can drive video signals through up to 1,000 ft. (305 m) of Extron Super High Resolution coaxial cable. Composite video is input and output on female BNCs.

Audio interfacing allows unbalanced audio to be converted to balanced line level stereo audio. Balanced audio eliminates noise usually associated with unbalanced audio when distributed over long cable runs. Audio input is accepted through two RCA stereo audio jacks, and audio is output on 3.5 mm captive screw connectors.

The USA/domestic version of the CVEQ1 includes a 110VAC, external power supply, while the world version includes a 100-240VAC, external power supply. For permanent installations, the CVEQ1 is also available as a stand-alone Architectural Adapter Plate (AAP) in three colors: grey, black, and white.

Extron CVEQ1 AAP

CVEQ1 Models

CVEQ1 (USA/domestic)
Part number: 60-360-01
$325.00* (US Dollars)

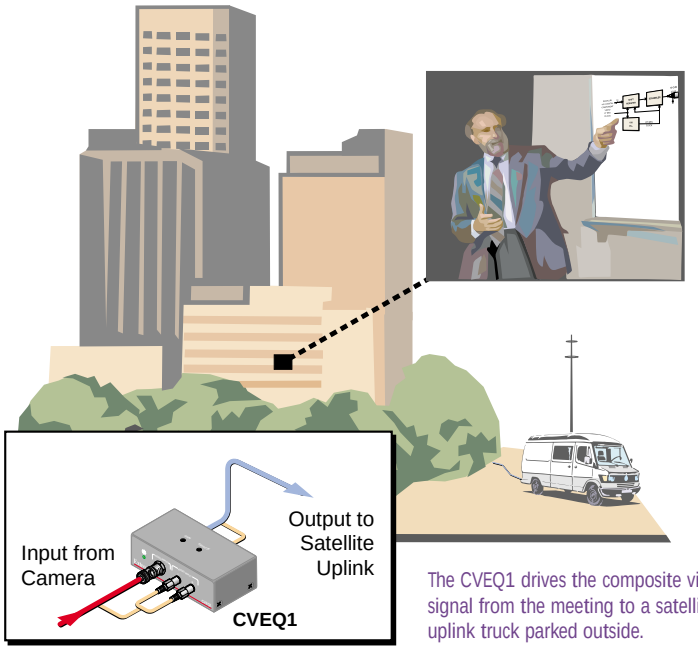
CVEQ1 (World)
Part number: 60-360-02
$380.00* (US Dollars)

CVEQ1 AAP Grey
Part number: 70-146-01
$290.00* (US Dollars)

CVEQ1 AAP Black
Part number: 70-146-11
$295.00* (US Dollars)

CVEQ1 AAP White
Part number: 70-146-21
$295.00* (US Dollars)

* Prices valid for US sales only.



The CVEQ1 drives the composite video signal from the meeting to a satellite uplink truck parked outside.

Extron SS 200 (Sync Stabilizer)

"Using the SS 200s let Shen Milsom & Wilke deliver a more cost-effective systems design to our client," says Emspak.

"Future Proofing" AT&T with A/V

In January of 1998, AT&T announced plans to build a state-of-the-art Global Network Operations Center (GNOC) in Bedminster, New Jersey. The international communications company stated that its objective for building the new facility was to "future proof" its network. Less than twenty-one months after ground was broken and at a cost of $91 million, that objective was met when the doors opened on the world-class command and control center.

AT&T's GNOC sits on a 200 acre campus an hour's drive from New York City. The operations center links 30 major metropolitan areas nationwide, serving roughly 80 million customers. The building, with its technology-infused infrastructure and unique architectural design, has few precedents. It covers four floors, two above ground and two below, for a total of 198,000 square feet of space.

Image 1. The Operations Theater is the hub of AT&T's Global Network Operations Center in Bedminster, NJ.

Designing the Facility

Plans for the center were in the works for two years before ground was broken on the project. AT&T's objective for building the operations center was driving every design aspect for the facility from the get-go. The building itself would serve several different purposes. In addition to being the nerve center of AT&T's domestic communications network, the facility would also be something of an ambassador for AT&T. The GNOC would be a place where AT&T could bring customers to experience first-hand what the company does. It would also provide a site to demo new products and launch new programs. Making the building "future proof" had a couple of different meanings from a design perspective. One, the data infrastructure had to be capable of handling as efficiently as possible any type or volume of traffic customers could generate. And two, because of the building's ambassador status, its physical design had to be on the bleeding edge of communications technology.

The end result is the GNOC plays three roles: it's a world-class command and control center; it hosts an elaborate visitors' program; and it supports a well-equipped corporate briefing center. To conceptualize and design the telecomm and A/V solutions needed for this extensive project, AT&T

contracted technology consultant firm Shen Milsom & Wilke.

World-Class A/V at the GNOC

The hub of the GNOC is the Operations Theater—a top-notch command and control center. Located 60 feet below ground on the floor of a three and a half story atrium, the Operations Theater is built on a gentle, 180 degree arc. (See **Image 1**.) Thirty-five control consoles face a wall of 141 rear projection screens stacked three high and 47 across.

Behind the scenes, LCD projectors illuminate the screens, which are fed by a 200 x 200 matrix switcher. Inputs to this switcher come from a number of different sources, including off-air television, direct satellite, broadcast news, weather stations, and AT&T's network monitoring system, which relies on 150-plus high resolution computer workstations. (See **Image 2**.)

The Operations Theater also plays a central role in the visitors' program. Visitors enter the building on the third floor and are led into a theater room. They are invited to sit in one of thirty comfortable seats facing a curved projection screen (8 ft. x 28 ft.) mounted on a 13 ft. x 50 ft. wall and watch a seven-minute presentation. The presentation runs off an SGI Onyx II computer and is choreographed to music. Three, high-brightness DLP projectors are blended together to provide a solid image on the large screen (See **Image 3**.). At the end of the presentation, the screen and the wall on which it's mounted are lifted quickly and silently into the ceiling, and visitors are suddenly looking through a bank of windows down at the Operations Theater 60 feet below.

Directly across from this Visitors' Observation Theater is another wallboard with 39 LCD projectors arranged in a 3 x 13 array. This display wall is fed from a video server and can also access sources from other areas of the GNOC. The wallboard is used for presentations and videoconferencing environments.

Image 2. LCD projectors display information on 141 rear-projection screens in the GNOC's Operations Theater.

Image 3. In the Visitors' Observation Theater at the AT&T GNOC, three high-brightness DLP projectors are blended together to provide a solid image on the large screen.

The Corporate Briefing Center was also designed to be on the cutting edge of A/V technology. It includes five briefing rooms and a product demonstration room. A master control room houses a variety of A/V equipment that is accessible to every room through a control system. Each room is equipped with a rear-screen projector, audio, videoconferencing equipment, and electronic whiteboards.

Making It Work—With Room to Grow

One big issue Shen Milsom & Wilke ran into when designing AT&T's GNOC was simply the mammoth size of the project. The magnitude of the A/V program meant a huge amount of cabling was necessary to

continued on next page

AT&T with A/V (cont.)

make it all work. Huge amounts of cable influenced the install in two main ways: cost and weight.

"Keeping in mind that we were dealing with 200 inputs and 200 outputs, cable cost was a significant issue due to the size of the switch," explains Steve Emspak, Principal with Shen Milsom & Wilke, who worked extensively on the project. "Cable density also became an issue when we realized that [because of the sheer magnitude of the installation] we had a significant amount of weight invested in the cables." Cable weight affects both the time and labor it takes to physically build an application, as well as potentially affecting the structural integrity of the building itself.

Emspak began looking for a way to cut down the number of cables he needed without affecting the signal quality of the install. His solution was to use 180 Extron SS 200 sync stabilizers directly in front of all LCD projectors—141 in the Operations Theater and 39 on the wallboard opposite the Visitors' Observation Theater.

The Extron SS 200 is a sync stabilizer that accepts RGBHV, RGBS, or RGsB and, utilizing a method exclusive to Extron, digitally restores the sync, providing a stabilized RGBS or RGBHV ouput signal. The SS 200 outputs simultaneously on five BNCs and a female 15-pin HD connector, so output can be sent directly to the projector no matter what type of input it has.

Using the SS 200, Emspak ran an RGsB video signal on three wires into and out of the 200 x 200 matrix switcher. He placed an SS 200 in front of each digital display and converted the RGsB to RGBHV, making a short, five-wire cable run directly into the projector. This technique let Emspak spec smaller, lighter cabling for the majority of the long cable runs throughout the GNOC.

"Using the SS 200s let Shen Milsom & Wilke deliver a more cost-effective systems design to our client," says Emspak. "The benefits appeared in a couple of areas." Running three-wire cable into and out of the switcher cut the cost and the labor expense. Using these sync stabilizers also meant Emspak could spec a three-level (RGB) matrix switcher instead of a four or five level switcher—enabling even more cost savings. Additionally, the SS 200s reduced the number of cables used from 6,000 to 4,000. This cut down the weight of the cable runs, as well as the number of equipment racks in the computer room, leaving room for future expansion. (See **Image 4**.)

Emspak was so pleased with the impact the SS 200s had on the AT&T install that he's used them to accomplish similar goals in other locations. "Since using the SS 200s for AT&T, we have had similar success with them where we needed to provide our clients with advanced A/V capabilities confined within a pre-existing infrastructure with limited conduit capacity," he says.

Today, the GNOC is on the leading edge of A/V technology. The SS 200s have helped make AT&T's Global Network Operations Center ready for the systems of tomorrow by leaving plenty of room to grow.

Image 4. Using the Extron SS 200 reduced the number of cables used, leaving room for future expansion.

RGB 160xi

Universal Mountable Interface with Female 15-pin HD Input, Audio, and ADSP™

Replacing the RGB 150xi is the Extron RGB 160xi with ADSP. It is a universal, analog computer-video interface with a female 15-pin HD input and buffered local monitor output. It accepts RGB signals and is compatible with VGA, SVGA, XGA, SXGA, UXGA, Mac, Sun, and SGI signals. Two optional mounting kits are available: an under-desk and through-desk version. The RGB 160xi features horizontal shift control, video gain and peaking control, as well as active PC audio interfacing for converting PC audio signals to balanced line level audio.

RGB 160xi

Part Number: 60-378-01
List Price: $755.00* (US Dollars)

URL:
www.extron.com/rgb160xi

* Prices valid for US sales only.

RGB 168xi

Universal Mountable Interface with Female 15-pin HD Input, Audio, ADSP, and Optional Architectural Adapter Plates

Replacing the RGB 158xi is the Extron RGB 168xi with ADSP. It is a universal, analog computer-video interface with a female 15-pin HD input and buffered local monitor output. It accepts RGB signals and is compatible with VGA, SVGA, XGA, SXGA, UXGA, Mac, Sun, and SGI signals. The RGB 168xi also includes an unswitched AC outlet and optional Architectural Adapter Plates for signal pass-through connectors. An optional under-desk mounting kit is available. The RGB 168xi features horizontal shift control, video gain and peaking control, as well as active PC audio interfacing for converting PC audio signals to balanced line level audio.

RGB 168xi

Part Number: 60-379-01
List Price: $895.00* (US Dollars)

URL:
www.extron.com/rgb168xi

* Prices valid for US sales only.

RGB 560

Architectural Universal Mountable Interface with Female 15-pin HD Input, Audio, and ADSP

Front

Back

Replacing the RGB 550 is the Extron RGB 560 with ADSP. It is a universal, analog computer-video interface with a female 15-pin HD input and buffered local monitor output. It accepts RGB signals and is compatible with VGA, SVGA, XGA, SXGA, UXGA, Mac, Sun, and SGI signals. The RGB 560 Architectural Interface is designed to fit flush in a wall, podium, desk, or other installation surface. The RGB 560 features horizontal shift control, video gain and peaking control, as well as active PC audio interfacing for converting PC audio signals to balanced line level audio. Available in three colors: grey, black, and white.

RGB 560

Part Number:	**List Price:**
60-381-01(grey)	$720.00* (US Dollars)
60-381-02 (black)	$730.00* (US Dollars)
60-381-03 (white)	$730.00* (US Dollars)

URL:
www.extron.com/rgb560

* Prices valid for US sales only.

RGB 568

Architectural Universal Mountable Interface with Female 15-pin HD Input, Audio, ADSP, and Optional Architectural Adapter Plates

Replacing the RGB 558 is the Extron RGB 568 with ADSP. It is a universal, analog computer-video interface with a female 15-pin HD input and buffered local monitor output. It accepts RGB signals in and is compatible with VGA, SVGA, XGA, SXGA, UXGA, Mac, Sun, and SGI signals. The RGB 568 also includes optional Architectural Adapter Plates for signal pass-through connectors. The RGB 568 Architectural Interface is designed to fit flush in a wall, podium, desk, or other installation surface. The RGB 568 features horizontal shift control, video gain and peaking control, as well as active PC audio interfacing for converting PC audio signals to balanced line level audio. Available in three colors: grey, black, and white.

RGB 568

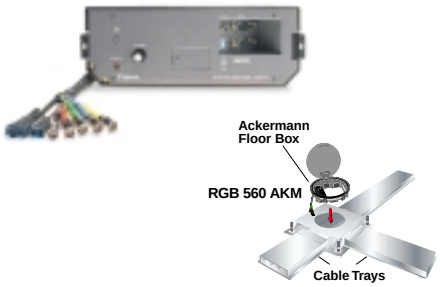
Part Number:	List Price:
60-383-01 (grey)	$750.00* (US Dollars)
60-383-02 (black)	$760.00* (US Dollars)
60-383-03 (white)	$760.00* (US Dollars)

URL:
www.extron.com/rgb568

* Prices valid for US sales only.

RGB 560 AKM

Universal Interface with Audio Interfacing, ADSP, and Female 15-pin HD Input for Ackermann Floor Boxes



Replacing the RGB 550 AKM is the Extron RGB 560 AKM. It is a universal, analog computer-video interface with audio interfacing and ADSP designed exclusively for Europe. It accepts RGB signals and is compatible with VGA, SVGA, XGA, SXGA, UXGA, Mac, Sun, and SGI signals. The RGB 560 AKM fits flush within an Ackermann GES9B box for easy installation into the Ackermann Floor tank system. This interface has a female 15-pin HD input and buffered local monitor output. The RGB 560 AKM features horizontal shift control, video gain and peaking control, as well as active PC audio interfacing for converting PC audio signals to balanced line level audio.

RGB 560 AKM

Part Number:	List Price:
60-384-01	$695.00* (US Dollars)

URL:
www.extron.com/rgb500-560akm

* Prices valid for US sales only.

P/2 DA2 WM F & P/2 DA2 WM F AAP

Universal Mountable Interface with Female 15-pin HD Input, Audio, and ADSP

P/2 DA2 WM F

P/2 DA2 WM F AAP

The Extron P/2 DA2 WM F is a wall-mountable, one input, two output, high-resolution distribution amplifier (DA) with audio. Input and outputs on this DA are female 15-pin HD connectors and both outputs are individually buffered. The P/2 DA2 WM F is installed using wall mount adapter plates and fits flush into a wall, podium, or table. The Extron P/2 DA2 WM F is available in an Architectural Adapter Plate version (P/2 DA2 WM F AAP). The AAP version offers various audio and video pass-through connectors for additional signal connections. Both models are available in three colors: grey, black, and white.

P/2 DA2 WM F & P/2 DA2 WM F AAP

P/2 DA2 WM F

Part Number:	List Price:
60-376-01 (grey)	$385.00* (US Dollars)
60-376-02 (black)	$395.00* (US Dollars)
60-376-03 (white)	$395.00* (US Dollars)
60-376-10 (EC-white)	$485.00* (US Dollars)

P/2 DA2 WM F AAP

Part Number:	List Price:
60-377-01 (grey)	$425.00* (US Dollars)
60-377-02 (black)	$435.00* (US Dollars)
60-377-03 (white)	$435.00* (US Dollars)
60-377-10 (EC-white)	$570.00* (US Dollars)

URL:
www.extron.com/p2da2wmf

* Prices valid for US sales only.

SW2 VGA DA2 AF R

Two Input, Two Output VGA and Audio Switcher/ Distribution Amplifier

The Extron SW2 VGA DA2 AF R is a combination two input, two output switcher/distribution amplifier. One 15-pin HD female connector and a 3.5 mm female audio jack connector are located on the front panel. All other connectors are on the back panel. The SW2 VGA DA2 AF R can be mounted in a rack or under a desk and is available with Architectural Adapter Plates for signal pass-through connectors. It has an internal power supply and an unswitched AC outlet. An auto-switching mode is available.

SW2 VGA DA2 AF R

Part Number: 60-368-01
List Price: $795.00* (US Dollars)

URL:
www.extron.com/sw2vgada2afr

* Prices valid for US sales only.

Hideaway HSA 400

Discreet Access to System Connection

Closed

The Extron Hideaway HSA 400 is the architectural solution for discreet access to A/V signals. Designed to mount in conference room and boardroom tabletops, the Hideaway HSA 400 keeps A/C power, phone, and CAT 6 network connections out of sight until needed. Four Architectural Adapter Plate spaces are available to configure connections for virtually any signal. *For optimal use of the Hideaway HSA 400, it can be coupled with the Extron RGB 580xi remote universal interface (see below).*

Hideaway HSA 400

Please call Extron for part numbers and pricing.

URL:
www.extron.com/hideawayhsa400

RGB 580xi

Architectural Universal Mountable **Remote Interface** with Audio Interfacing and ADSP for Out-of-Sight Installations

RGB 580xi

The Extron RGB 580xi is a universal, analog computer-video interface with audio interfacing and ADSP. The Interface enclosure is designed to mount out of sight. User connections and controls are accessed remotely through a two-space AAP. The RGB 580xi has a female 15-pin HD input connector. It accepts RGB signals and is compatible with VGA, SVGA, XGA, SXGA, UXGA, Mac, Sun, and SGI signals. Architectural Adapter Plates are available with various input connection configurations, colors, and cable lengths. The RGB 580xi features horizontal shift control, separate variable level and peaking controls, as well as active PC audio interfacing for converting PC audio signals to balanced line level audio. *The RGB 580xi is and ideal integration solution with Extron's Hideaway HSA 400 (see above).*

RGB 580xi Architectural Adapter Plates

RGB 580xi

Part Number: 60-362-01
List Price: $950.00* (US Dollars)

URL:
www.extron.com/rgb580xi

* Prices valid for US sales only.

Digital XPoint Series
Serial Digital Video Matrix Switchers

DXP 88 SDI

The Digital XPoint Matrix Switcher Series is the ideal solution for switching multiple serial digital video signals to multiple digital video devices in video production studios, non-linear editing suites, and video broadcast studios. Currently, there are two models available in the Digital XPoint line: an 8 x 8 model (DXP 88 SDI) and a 4 x 4 model (DXP 44 SDI). These switchers feature automatic rate selection of four SMPTE 259M data rates: 143, 177, 270, 360 Mbps. They can handle 4fsc (composite) or 4:2:2 (component) serial digital transmission standards. The Digital XPoint line comes standard with front panel control. Remote control is available using Extron's remote keypad (MKP 1000) and/or remote control panel (MCP 1000). Control using a third party control system can be done via RS-232 or RS-422.

Additional features include:

- Inputs with equalized and buffered loop-throughs
- Outputs on two buffered and re-clocked BNCs
- Digital Sync Validation Processing (DSVP™): when input serial data is locked, matrix indicates the presence of a carrier source and data rate
- Automatic rate selection: the matrix automatically accepts four SMPTE 259M data rates (143, 177, 270, 360 Mbps).
- Automatic input cable equalization

Digital XPoint Series

DXP 88 SDI
Part Number: 60-401-01

DXP 44 SDI
Part Number: 60-402-01

URL:
www.extron.com/digitalxpoint

Please call Extron for pricing.

SDI-AVR 100 and HDSDI-ACR 100
SDI to Analog Video Converters

SDI-AVR 100

HDSDI-ACR 100

The Extron SDI-AVR 100 is a 10-bit Serial Digital Interface (SDI) to analog video signal converter, and the Extron HDSDI-ACR 100 is a 10-bit High Definition Serial Digital Interface (HDSDI) to analog video signal converter. The SDI-AVR 100 and the HDSDI-ACR 100 are ideal for integrating SDI or HDSDI sources into an analog video environment. Example applications include presentations using disk recorders, video production, non-linear editing stations, monitoring, and staging events.

The rack-mountable SDI-AVR 100 and the HDSDI-ACR 100 provide input equalization and a re-clocked loop-through for the SDI or HDSDI input.

SDI-AVR 100

The SDI-AVR 100 accepts component SDI (4:2:2) in ITU-R BT 601 format. It auto-detects input format and de-serializes the 270 Mbps digital stream. The SDI-AVR 100 outputs composite video and S-video (Y/C) simultaneously, with the third output available as component video (Y, R-Y, B-Y) or RGB (RGsB, RGBS, or RGBHV). There is a choice of output formats: NTSC or PAL. NTSC and PAL color bar test patterns are provided for setup and troubleshooting of systems.

HDSDI-ACR 100

The HDSDI-ACR 100 accepts HDSDI at (720p, 1080i, and 1080p) with rates up to 1.5 Gbps. The HDSDI-ACR 100 outputs component video (Y, R-Y, B-Y) or RGB (RGsB, RGBS, or RGBHV). Bi-level or tri-level sync is available with component video output.

SDI-AVR 100 & HDSDI-ACR 100

SDI-AVR 100
Part Number: 60-400-01

HDSDI-ACR 100
Part Number: 60-408-01

URLs:
www.extron.com/sdiavr100
www.extron.com/hdsdiacr100

Please call Extron for pricing.

Extender WM, Extender AAP, Extender WM AAP, and Extender MK

VGA-UXGA Line Drivers with Audio

Extender WM

Extender AAP

Extender WM AAP

Extender MK
(Includes black & white faceplates)

The Extron Extender product line is a family of one input, one buffered output VGA-UXGA line drivers with audio. The Extender family is comprised of four models: Extender WM, Extender AAP, Extender WM AAP, and Extender MK. Offering 320 MHz (-3dB) RGB video bandwidth, each line driver sends a high resolution computer-video signal up to 250 feet (76.2 m) through high-quality cable, such as Extron's BNC-5 Mini HR Cable. A three position video peaking/gain adjustment compensates for signal losses over long cable runs.

Video input is accepted on a 15-pin HD female connector. Video output is on a three inch (7.6 cm) pigtail, with female BNCs, for simple and versatile connections. The Extender products are compact, so even when using an Extender product with a single-gang electrical box, or an MK box, there will still be enough room to make all the connections inside the box. For discreet architectural integration, the faceplate is available in three colors: grey (except for the Extender MK), black, or white, and it may be easily replaced by a custom faceplate.

Audio interfacing allows PC audio to be converted to balanced line level stereo audio. Balanced audio eliminates noise usually associated with unbalanced audio when distributed over long cable runs. Audio input is accepted on a 3.5 mm female audio jack. Balanced or unbalanced audio is output on an easy-to-use retaining screw connector.

Each Extender accepts 9-24VDC on a convenient retaining screw connector. Each USA/domestic version includes a domestic, external power supply, while each world version includes a 100-240VAC, external power supply. The Extender MK is available only in a world version.

MOUNTING CONFIGURATIONS:

Extender WM

The Extender WM can be wall-mounted in a one-gang box and fits flush into a wall, podium, or table.

Extender AAP

The Extender AAP is a stand-alone, double-space Architectural Adapter Plate (AAP). The Extender AAP fits into single-gang AAP spaces of Extron's architectural interfaces or distribution amplifiers with AAP openings.

Extender WM AAP

The Extender WM AAP is like the Extender WM, but has openings for four of Extron's optional, single-space (or two double-space) Architectural Adapter Plates (AAPs). The Extender WM AAP can be wall-mounted in a three-gang box and fits flush into a wall, podium, or table.

Extender MK

For convenient and easy installation, the Extender MK fits flush within an electrical knock-out switch box (also known as a KO box or MK box), a box frequently used in countries such as Singapore, the United Kingdom, and Australia. The Extender MK is small and allows the BNC, audio, and power connection cables to fit within the shallow depth of the knock-out (KO or MK) box. Two faceplates, black and white, are included.

Extender Models

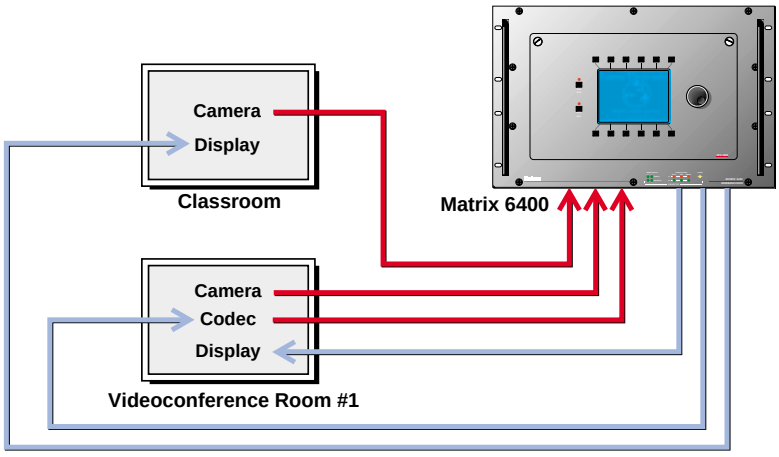
Please call Extron for part numbers and pricing.

URL:
www.extron.com/extender

Part 3: Multiple Scenarios for a Videoconferencing Environment

We set the stage for a standard videoconference in our last two issues. First, we put together a basic setup plus a computer-to-video scan converter for incorporating PC images. Then we added a little complexity and flexibility by incorporating a multi video processor, so multiple sources can be simultaneously displayed to far-end participants. Now let's add another variable to the videoconference equation—multiple sources and destinations, in rooms other than the dedicated videoconference room.

If you have ever come across the task of designing a system to accommodate a number of different videoconferencing scenarios: large audience, small audience, or both simultaneously, you know this can be tricky. When designing VC capabilities into Extron's S3 Technical Institute, we knew that a standard, small venue videoconference would typically be held in one of two dedicated videoconference rooms. But the prospect of accommodating a larger audience created another situation. We needed to be able to conduct a videoconference in one of the larger training rooms, or to conduct a single videoconference simultaneously in multiple rooms. To route the videoconference signal to any display in any room, we used Extron matrix switchers.



This simplified routing diagram illustrates how two rooms can share videoconferencing capabilities via an Extron Matrix 6400 Switcher. The videoconferencing codec and cameras in one or both rooms feed the matrix. Outputs can then be sent to the videoconferencing codec and displays in either or both rooms. (See illustration on next page.)

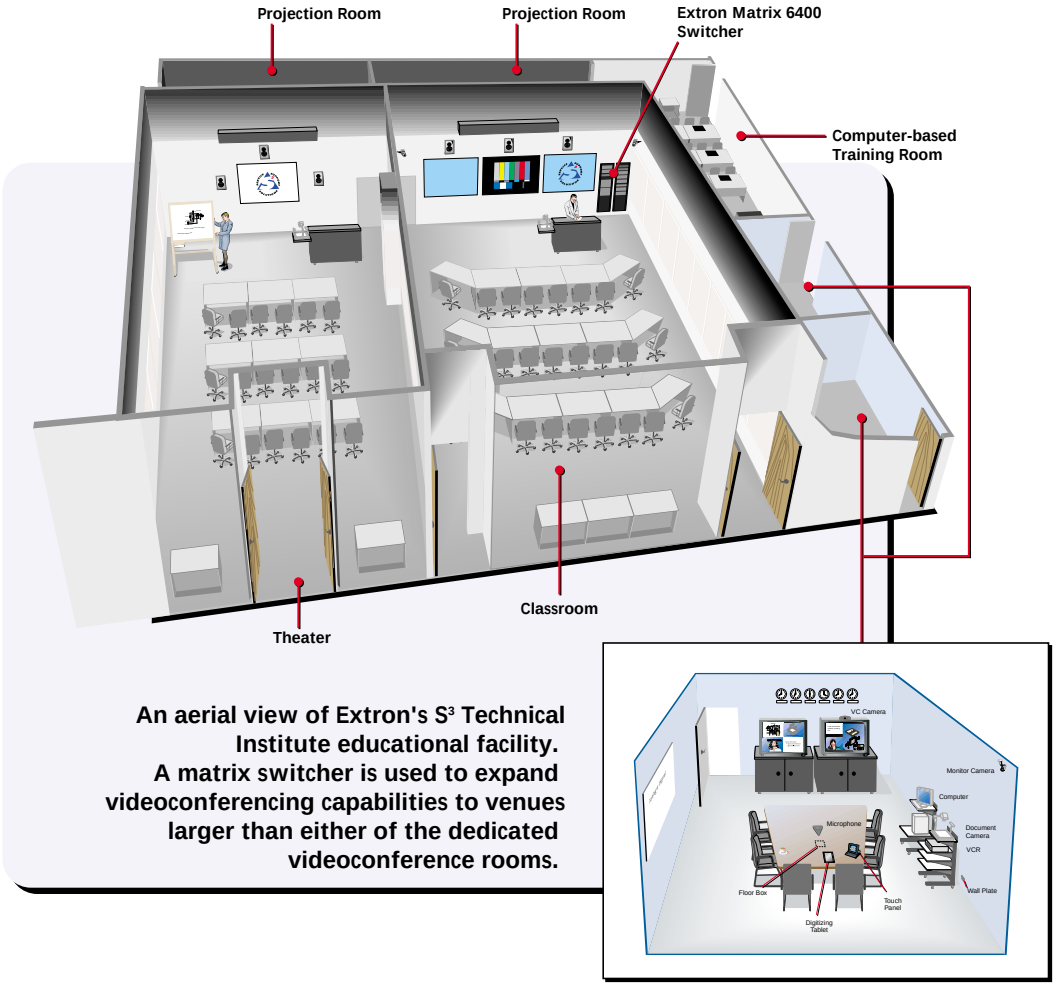
Matrix Switching

A matrix switcher is a specific type of switcher that routes multiple inputs to multiple outputs. Internally, a matrix switcher consists of a series of distribution amplifiers and switchers, housed in a single enclosure and controlled by remote or front panel controllers. Matrix switchers, depending on the specific model, are able to route composite video, S-video, HDTV/component video, RGsB/RGBS/RGBHV video, SDI, and/or stereo audio (balanced/unbalanced) signals. Matrix switchers are commonly used in applications such as presentations, data display, and entertainment, and they can be a perfect fit for a more complex videoconferencing environment.

To provide total solutions for different routing applications, Extron's matrix switchers offer a variety of features and are available in input/output configurations from 4 x 4 up to 256 x 256. Your selection will depend on the size of the videoconferencing facility and other applications your matrix may be used for. Some facilities may benefit if the videoconferencing and A/V presentation systems share the same matrix switcher; the product sharing may well result in reduced costs, increased signal routing flexibility, and less need for A/V equipment rack space.

Videoconferencing in a Multi-Room Facility

The illustration (on page 21) depicts two dedicated videoconference rooms and additional VC-enabled rooms. In the Extron S3 Technical Institute, Extron Matrix 6400 Switchers make our multi-room videoconference concept a reality; any



An aerial view of Extron's S³ Technical Institute educational facility. A matrix switcher is used to expand videoconferencing capabilities to venues larger than either of the dedicated videoconference rooms.

video and/or audio input can be routed to any output throughout the entire training facility, including to and from either codec. Any room can hold a videoconference. A videoconference held in the classroom can be routed to other rooms that hold additional participants or audience members. Whether a classroom session or meeting is local or needs to be delivered to a distant site, the matrix can handle it—including routing any video camera signal in any room to any display in any room. With this level of integration built into the system, a videoconference of any size is feasible.

For our next installment, we tackle this question: how does the placement of cameras and microphones make an impact on a presentation? We will talk about audio and point of view in a videoconferencing environment

Remember, you can call Extron for all your videoconferencing solutions or troubleshooting issues at: 800.633.9876.

UTP Technology

Extron recently developed a white paper on UTP to provide a better understanding of UTP technology and installation and test issues. This can be found on our Web site at http://www.extron.com/utptechnology. The following is a condensed version of the UTP white paper.

One problem with twisted pair wire is electromagnetic emissions at high frequencies. These emissions can couple into adjacent twisted pairs. The second issue is the ability of the cable to eliminate common mode noise. Common mode noise is electrical interference induced into the cable with equal amounts of energy, in the same polarity, on both wires of a twisted pair. This can come from sources like electric motors, air chillers, power transformers, fluorescent lighting ballasts, etc.

In a well-designed and balanced multi-pair Category 5/5e/6 cable with consistent twist ratios and matched pair lengths, the electromagnetic interference (EMI) being emitted from the pair is reduced significantly. In addition, common mode noise from external interference and adjacent pair crosstalk is significantly improved. To see how this is important, we first must understand what happens when a balanced signal is applied to a twisted pair of wires. When a transmitter applies a balanced analog audio or video signal to a twisted pair wire, the signal is the same amplitude (voltage level) on both wires, but the signal on one of the wires is inverted to the opposite polarity. When the signal on one wire is going in a positive direction, the signal on the other wire is going in a negative direction. This is referred to as differential mode. See **Figure 1**.

All induced common mode noise from adjacent wire pairs, as well as from other external sources such as motors, transformers, and other external sources, will cause the same noise signal to be induced into both wires equally and of the same polarity. This will cause electrons to flow in the same direction through both wires of the twisted pair, and the noise will cancel at the receiver. In balanced transmissions, the receiver is operating in a differential mode. This means it is looking for a difference between the two input signals to form an output signal. The receiver has a positive and negative input, sometimes referred to as the Tip and Ring inputs, respectively. The differential receiver performs a simple math function: it inverts the sign (polarity) of the signal at the negative input to a positive value and adds the value of the two input signals together.

When common mode noise is present on the twisted pair, the noise is equal in amplitude and always of the same polarity on both wires. The differential receiver processes this common mode noise in the same way as it did the signal. If we have +0.015 volts of common mode noise at both inputs, change the sign of the common mode noise at the negative input to –0.015 volts, and add the two inputs together. They will cancel out and only the original signal will be present at the output of the receiver. This would still be true if the common mode noise were negative at both inputs.

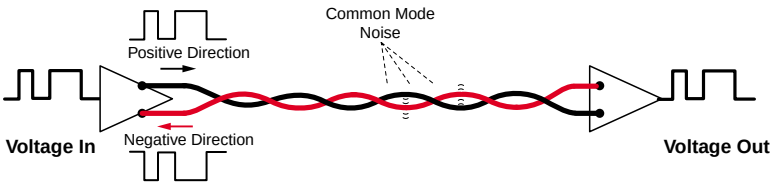


Figure 1. Common mode noise: The noise is at the same level traveling in the same direction at the same time. The noise will cancel at the receiver.

If for any reason the wires in a twisted pair were to become separated—like from a sharp bend during installation—the noise will strike the wires at slightly different angles, causing the induced signals (noise) to be slightly different in each wire. This difference will not cancel out at the receiver and, thus, will become part of the signal. At the same time, this separation will form a loop (See **Figure 2**) and will act as a loop antenna, picking up additional unwanted noise/crosstalk.

Figure 2. Twisted pair showing damaged twist pattern.

Cable Testing

This is not a coax cable; it is not a "just crimp on some BNC connectors and turn everything on" type of application. As people in the data world know, it is very important that this cable run be tested to meet the stringent requirements of the Category 6 specification (the higher the quality of cable is, the higher the performance that results). The following is a brief summary of common UTP cable tests.

Wiremap Test

The Wiremap Test is used to identify installation-wiring errors:

- Proper pin termination at each end
- Continuity to the remote end
- Shorts between any two or more conductors
- Crossed pairs
- Split pairs
- Reversed pairs
- Any other mis-wiring.

Attenuation Test

The loss of signal strength (or voltage) in the cable is called attenuation. The more attenuation there is, the less signal there will be present at the receiver. The attenuation is measured in decibels (dB). Attenuation increases with distance and frequency. For every 6dB of loss, the original signal will be half the original amplitude.

Length Test

Structured cable systems for the data world have a length limit of 328 feet (100 meters) total. (Note: this restriction does not directly apply to the transmission of analog signals.) The length test will provide us with the physical length of each pair and the delay time in nanoseconds.

The delay skew is the difference in time it takes for a signal to travel down the shortest pair to the time it takes to travel down the longest pair. Lengths of wire pairs often vary within the same UTP cable due to small differences in twist tension and rates. The delay skew is measured in nanoseconds (ns) and feet.

Using Belden Media Twist cable for our reference, each foot has a delay of 1.451 ns. If there was a delay skew of five feet between a pair of wires, the delay in nanoseconds would be 7.255 (5 feet x 1.451 ns). This would be very close to one pixel width off at the 1280 x 1024 rate and half a pixel width off at the 1024 x 768 rate. If this delay skew is not compensated for, the image will appear to be out of convergence because the red, green, and blue signals will arrive at different times. Delay skew is caused by differences in length between one or more of the pairs. Correcting for delay skew can be done by simply inserting additional cable in line with one or more short pairs after the receiver has output them on coax. See **Figure 3** (below).

Return Loss Test

Return loss is a measurement of the reflected signal back toward the transmitter. This reflected energy is caused by variations of impedance in the cable and connectors. See **Figure 4** (below). This would be the equivalent of an electrical echo of the original signal. It is like when your TV is switched to a weak station and you see that the image is full of ghosts.

Near-End Crosstalk (NEXT)

The NEXT measurement is the amount of signal that is induced into an adjacent twisted pair at the transmission end by the electromagnetic field created by the signal being transmitted through an adjacent pair at the same end. The untwisting of the cable that is required to make the termination makes this the most vulnerable part of the assembly process. Electromagnetic emissions become greater with increases in the frequency of the signal, and thus, crosstalk increases with increases in frequency.

Equal Level Far-End Crosstalk (ELFEXT)

ELFEXT is a very important measurement for our application. This is the crosstalk that reaches the receiver and has automatically had its results compensated for by variations in cable length. A short run will have less attenuation and therefore have a higher Far-End Crosstalk (FEXT) reading than a longer cable. The ELFEXT measurement automatically adjusts the FEXT results for the difference in cable lengths.

For the full UTP technology article, please visit our web site at http://www.extron.com/utptechnology.

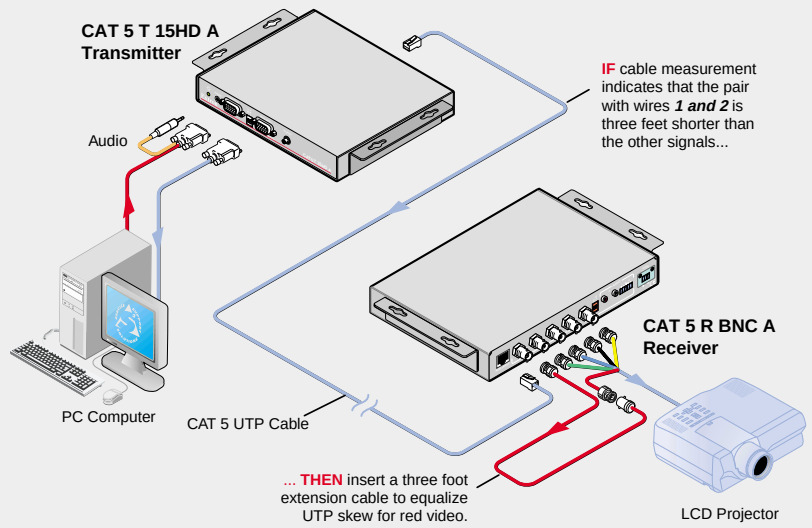

CAT 5 T 15HD A
Transmitter
IF cable measurement indicates that the pair with wires 1 and 2 is three feet shorter than the other signals...
Audio
CAT 5 R BNC A
Receiver
PC Computer
CAT 5 UTP Cable
... THEN insert a three foot extension cable to equalize UTP skew for red video.
LCD Projector

Figure 3. A length of coaxial cable is added to compensate for delay skew.

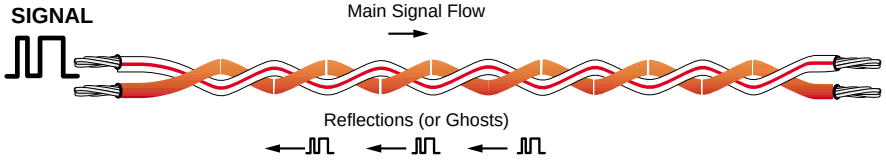


Figure 4. Reflected energy caused by impedance variations.

ExtroNews publishes information about new products that are relative to the Extron product line in the New News section. Also listed are the recommended Extron products that will complement these new display devices in their targeted applications. If you would like a new product to be reviewed for New News, please send a press release, literature, contact name, and a four-color slide or photo to: **New News c/o Ginger Dodier, Extron Electronics, 1230 South Lewis Street, Anaheim, CA 92805, phone: (714) 491-1500, ext. 6270 or e-mail to gdodier@extron.com**

Christie Digital Systems
www.christiedigital.com

Christie Digital Systems announces the **Vivid Green**—the first in a series of new Vivid projectors designed for conference rooms, boardrooms, churches, training rooms, and other venues. This LCD projector delivers 3600 ANSI lumens, true XGA resolution, and 300:1 contrast ratio. It weighs 17.2 lbs (7.8 kg), and it is compatible with NSTC, PAL, and SECAM composite and S-video, as well as PC computer, DVI-D, STV, DTV, and HDTV sources. The suggested list price is $12,495 (USD).

Recommended Extron product:
The **System 7SC** switcher will add the finishing touch to conference rooms, boardrooms, churches, training rooms, and other venues utilizing the Vivid Green projector. The System 7SC is a seven input, dual output switcher with scaling capabilities and advanced film mode processing with 3:2 pulldown detection for NTSC and 2:2 film detection for PAL. Six of the seven inputs of the System 7SC accept composite video, S-video, component (including HDTV), or RGBHV, and the seventh input accepts composite video, S-video, or RGBHV. Audio is available on all seven inputs with adjustable gain and attenuation for each input. The scaled output of the System 7SC can be configured to match the Vivid Green's XGA resolution. RGB signals are passed through. The System 7SC also offers projector and room control.

Vivid Green

Digital Projection, Inc.
www.digitalprojection.com

Digital Projection, Inc., has introduced the **HIGHlite 6000sx** DLP projector. This SXGA projector features 5000 ANSI lumens and 400:1 contrast ratio. It is ideal for mid- to high-end staging applications as well as permanent installations. It is compatible with all common video, computer and HDTV (480p, 720p, and 1080i) sources, and it also offers optional Serial Digital Interface (SDI) and High-Definition SDI (HDSDI) inputs. Suggested list price is $59,995 (USD).

Recommended Extron products:
For staging applications, the **SGS 408** seamless graphics switcher will complement the HIGHlite 6000sx. The seamless cuts, dissolves, wipe, and title/effects of the SGS 408 bring professionalism and style to live presentations. The SGS 408 incorporates two video scalers plus a digital video mixer and can manage component as well as any type of RGB input from video sources up to 1600 x 1200 resolutions. Additionally, if the SDI input option is chosen, Extron's new **Digital XPoint** line of Serial Digital Interface (SDI) matrix switchers will allow multiple serial digital video devices to be routed to multiple 6000sx projectors. Currently, there are two models available in the Digital XPoint line: an 8 x 8 model (**DXP 88 SDI**) and a 4 x 4 model (**DXP 44 SDI**).

HIGHlite 6000sx

Mitsubishi Digital Electronics America
www.mitsubishi-presentations.com

Mitsubishi's Presentation Products Division delivers the **X80** LCD projector for conference rooms and portable environments. It offers 1,500 ANSI lumens, 300:1 contrast ratio, and native XGA resolution. It weighs 7 lbs (3.2 kg). The X80 also introduces sRGB Color Mode, which is a system of color spaces that determines tone, saturation, and brightness; and sRGB claims to display the same natural color tones of CRT displays. It accepts these composite and S-video formats: NTSC, NTSC 4.43, PAL, and SECAM, as well as PC and workstation computers. List price is $7,495 (USD).

Recommended Extron product:
For conference room installations and portable applications, the **System 5cr Plus** adds additional inputs to the X80 projector and provides room control. The System 5cr Plus is a five input, one output, A/V integration switcher with an internal audio amplifier. It provides a total of five inputs—two for composite or S-video, two for RGBHV, and one that is configurable for composite, S-video, or RGBHV. The System 5cr Plus can control power on/off, mute, and input selection for the X80. This is an inexpensive solution for projector and room control of smaller-scale A/V installations.

X80

NEC Technologies Inc.
www.nectech.com

NEC Technologies Inc. announces the availability of the **PlasmaSync 50MP1** for applications such as conference room and board room presentations; training and broadcast facilities; and videoconference suites. The 50-inch XGA plasma offers 1365 x 786 resolution and can display sources up to UXGA. Some of the features include split screen multi-source display, picture-in-picture display options, and built-in stereo audio, and an inverse mode to display inverted RGB color values. List price is $18,995 (USD).

Recommended Extron products:
The **SW VGA** switchers and **P/2 DA** distribution amplifiers are additions that can multiply the 50MP1's inputs or the PC's outputs. The SW VGA series are 2, 4, or 6 input switchers with 15-pin HD connectors. The switchers allow multiple PCs to be switched to one plasma. The P/2 DA 2, 4, or 6 distribution amplifiers strengthen the PC signal and distribute one PC's signal to additional NEC plasmas or projectors. Connecting all these components together are the Extron **15-pin HD cable assemblies**. These cables are offered in plenum and non-plenum jackets, and some offer gender choice at the cable ends, as well as the capability of carrying audio in the same jacket.

PlasmaSync 50MP1

Sharp Electronics Corp.
www.sharp.com

Sharp Electronics Corp. announces shipment of the **LC-28HM2** widescreen 28 inch (71 cm) LCD video monitor for applications that include television broadcast and production, videoconferencing, transportation, entertainment, and tradeshows. The LC-28HM2 offers stereo audio, is 2.3 inches (58.4mm) deep, and weighs 23.5 lbs (10.7 kg). It provides 1280 x 768 resolution; accommodates VGA– XGA PC computers; and accepts composite, S-video, component, HDTV, and DVD video signals. Suggested list price is $16,995 (USD).

Recommended Extron products:
For switching and distribution of HDTV/component and computer signals to the LC-28HM2, Extron offers a selection of switchers and distribution amplifiers (DAs). For HDTV/component applications, the **SW 6 Component** switcher allows multiple HDTV images to be switched to one monitor, and the **ADA 6 Component** distribution amplifier allows one HDTV image to be displayed on multiple monitors. For computer applications, the SW VGA switchers and P/2 DA distribution amplifiers can be used. The **SW VGA** series are 2, 4, or 6 input switchers with 15-pin HD connectors. The **P/2 DA** 2, 4, or 6 or Wall Mount (WM) series distribution amplifiers strengthen the PC signal and distribute the PC's signal to multiple monitors.

LC-28HM2

Sony Electronics
www.sony.com

Sony Electronics unveiled the **VPL-FX50** LCD projector for installation applications such as conference and boardrooms. It has 3500 ANSI lumens, has native XGA resolution, and weighs 23 lbs (10.4 kg). It also has a network connection. It accepts a variety of input video sources including composite, S-video, component, RGB video, DVI, and computer signals up to UXGA. It is also compatible with a range of HDTV and DTV signals. The suggested list price is $14,000 (USD).

Recommended Extron products:
When using the DVI (Digital Visual Interface) input of the VPL-FX50 LCD projector, the **DDTX/DDRX DVI** driver will lengthen the distance run, and the **D/2 DA4 DVI** distribution amplifier will multiply the output of the PC's DVI graphics card. Since the DVI signal is recommended for runs up to 15 feet (4.6 m), the DDTX/DDRX DVI driver allows the signal of the DVI card to be driven up to 330 feet (100m) using Extron's SHR cable. If multiple VPL-FX50 projectors are needed, the D/2 DA4 DVI distribution amplifier splits the signal of the DVI graphics card to four outputs.

VPL-FX50

Introducing New Curriculum from Extron Institute

For five years, A/V professionals have been sharpening their industry knowledge through classes conducted by Extron Electronics. To keep you ahead of the rapid pace of change sweeping over this industry, we recently updated the Extron School curriculum and restructured school courses under a new organization—The Extron Institute.

The Extron Institute takes Extron School curriculum to a higher level. This in-depth education and training program is specifically tailored for Extron Dealers to keep you in the know about the latest technologies and product solutions. Currently, there are two different schools offered through Extron Institute. Each school consists of two consecutive days of coursework and hands-on training.

The School of A/V Technologies is an updated version of some of the classic topics covered during Extron School. Topics like Video Bandwidth, System Switching, Matrix Switching, and Computer-Video Interfacing are explored with the most up-to-date information available.

The second school, the School of Advanced A/V Technologies, consists of all-new coursework. It is designed for professionals with extensive industry experience (five years or more) who are looking to push their knowledge to a higher level. Courses in the advanced school explore topics in great technical detail with a heavy focus on how the technology works. To receive the maximum benefit from this advanced level course, attendees should have already completed the School of A/V Technologies.

Training room at Extron, Anaheim, CA.

The Advanced classes cover the following topics:

• *UTP cabling*– This class covers the ins and outs of using Category 5e/6 cabling for running video and audio signals. Key points such as NEXT, FEXT, skew, and attenuation are addressed, as are misconceptions about using this type of cable. Attendees will leave this class with a thorough understanding of when or when not to use Cat 5e/6 as a method of sending audio/video signals over long distances.

• *Advanced Switching Methods*– This class takes an in-depth look at the latest technologies driving high performance switching applications. Topics like seamless video switching for standard NTSC/PAL signals and high-resolution RGBHV signals, vertical interval switching, genlocking equipment, and the use of time base correctors with equipment that cannot accept a reference signal are explored in-depth.

• *Scalers: What, Why, When?*– This class explains exactly what scalers are, how they work, and why they are becoming such popular solutions to particular A/V applications. By the end of this class, attendees will know how to choose the appropriate scaler for any environment and describe the benefits they can bring to a system.

• *Digital Video Interfacing*– This class explores in detail the new digital technologies that are becoming more common in the professional A/V industry. It describes how digital interfacing works, its limitations, and the digital solutions available from Extron.

In addition to giving A/V professionals a valuable dose of industry information, Extron Institute schools qualify as CTS (Certified Technical Specialist) re-certification units. Each school gives attendees eight renewal units toward the 30 required to maintain certification. (For more information, go to the ICIA Web site at: www.icia.org.)

The world-class Extron S3 Technical Institute training facility in Anaheim hosts both schools. In addition, the School of A/V Technology is held in various locations around the country, in Europe, and in Asia. For complete course descriptions and the latest Institute schedule, go to the Extron Web site at www.extron.com. To make your reservation for an upcoming school offered by the Extron Institute, contact your Customer Support Representative.

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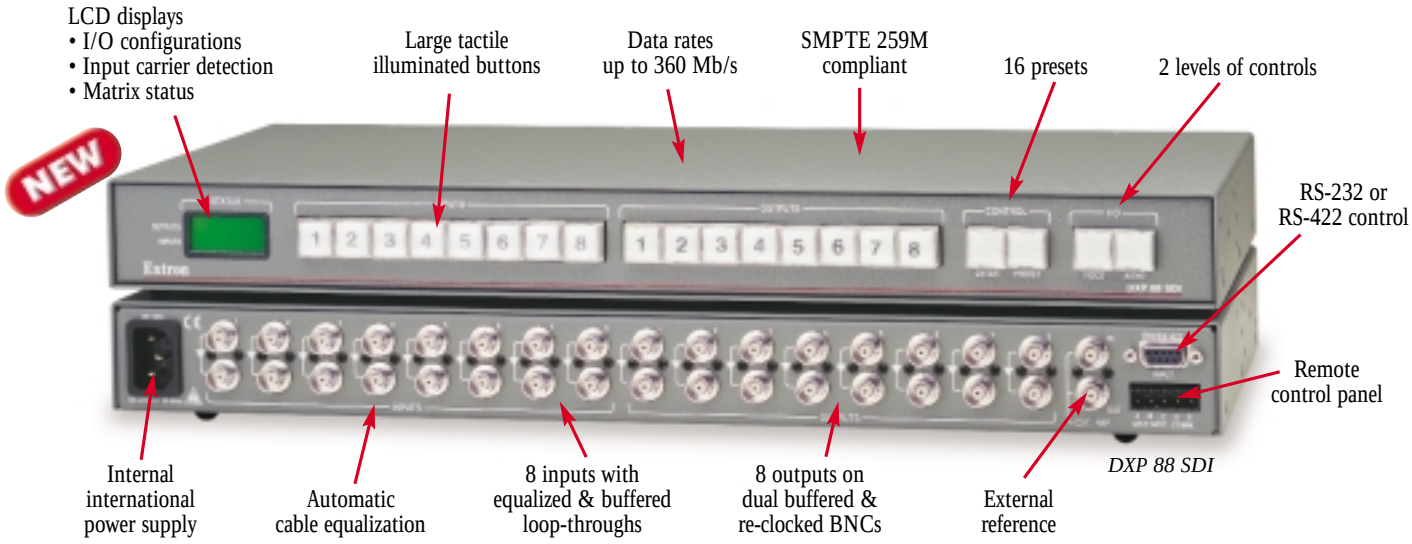
Extron Europe: +800.EXTRON.S3
Extron Asia: +65.383.4400.



DIGITAL XPOINT

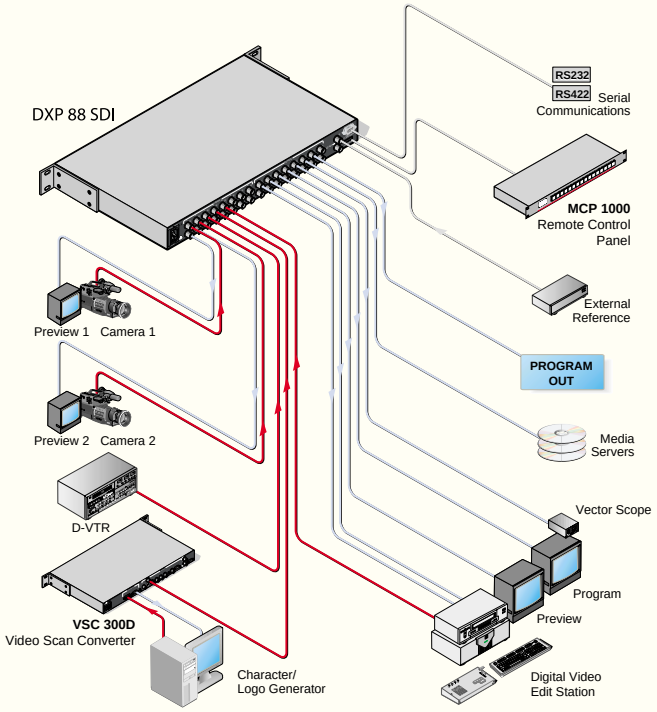
Extron® Matrix Switchers Go Digital

Introducing Digital XPoint—the new line of digital matrix switchers from Extron Electronics. The Digital XPoint matrix switcher line is the ideal solution for switching multiple serial digital video signals to multiple digital video devices in production studios, staging applications, non-linear editing suites, and broadcast studios.

Currently, the Digital XPoint line includes two models: the DXP 88 SDI (eight input, eight output) model and the DXP 44 SDI (four input, four output) model. Digital XPoint matrix switchers come standard with front panel control. Remote control is available using Extron's remote keypad (MKP 1000) and/or remote control panel (MCP 1000). Control using a third party control system can be done via RS-232 or RS-422.

Features:

- Inputs with equalized and buffered loop-throughs
- Outputs on two buffered and re-clocked BNCs
- Automatic rate selection—the matrix can automatically accept four SMPTE 259M data rates, including: 143, 177, 270, 360 Mbps. It's capable of switching 4fsc (composite) or 4:2:2 (component) serial digital video transmission standards.
- Automatic input cable equalization—typically equalizes greater than 300m at 270 Mbps of Extron SHR or equivalent high quality cable
- Digital Sync Validation Processing (DSVP™)—when input serial data is locked, the matrix indicates the presence of a carrier source and data rate
- 16 global memory presets
- Extron's Simple Instruction Set (SIS™) for easy to use RS-232 control



For complete details, visit Extron's Web site at:
www.extron.com/2/digitalxpoint

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Tweeker Use #59

Fishing Lure

Ken Carruth with American Electronics in Baton Rouge, is an avid sport fisherman. He has a special lure he designed that's almost guaranteed to land a big one. Next time you're reaching into your tackle box, instead of grabbing a Mister Twister®, try out Ken's Creeker Tweeker!

Send us your photograph of how you use the Tweeker. If we publish it in a future issue of ExtroNews, we'll give you a free **VTG 150.** Please send entries along with an explanation and photo to:

Extron Tweeker Contest
1230 South Lewis Street
Anaheim, CA 92805.

Or e-mail a high resolution photo and explanation to tweeker@extron.com

Extron Institute Upcoming Schedule, 2001

May 3-4	Singapore
May 10-11	Anaheim, CA
May 14-15	The Netherlands
May 14-15	Philadelphia, PA
May 16-17	Philadelphia, PA
June 16-17	Las Vegas, NV
June 25-26	The Netherlands
July 12-13	Anaheim, CA
July 16-17	Seattle, WA
August 2-3	Singapore
August 16-17	Anaheim, CA
August 20-21	Dallas, TX
August 22-23	Dallas, TX

Upcoming Tradeshows, 2001

April 23-26	NAB	Las Vegas, NV
June 13-15	INFOCOMM	Las Vegas, NV
August 29-31	INFOCOMM Japan	Tokyo, Japan

ExtroNews

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We welcome your comments and contributions! Please submit ideas to:

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